

The effect of lactobacilli starter culture on quality of bread

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Abstract

The aim of this work was both production, and physical and sensoric evaluation of various bread types with utilisation of sourdough. The sourdough was prepared from starter culture containing lactobacilli isolated from Slovak bakeries. The sensoric evaluation was done by ten trained evaluators according to ISO 8586. In addition to the sensory influence of sourdough, the physical properties, such a specific volume, shape, penetrometer number were investigated. The results show that the sourdough fermentation improve quality parameters of whole grain, fibber-rich products.

Keywords: lactic acid bacteria, sourdough, starter cultures, bread, sensory properties

Introduction

Recent trends in global production, processing, distribution are creating an increasing to demand for health and safety foods, although optimal sensory characteristics are pre-requisite for any successful fermented products. Bread and bakery products have an important role in human nutrition. Generally, wheat bread is considered to be a good source of energy and irreplaceable nutrients for the human body. This is especially true for the product made from wholegrain or high-fibre flour. There is increasing evidence that the intake of whole grain foods and cereal fibre against chronic diseases, such as type 2 diabetes and cardiovascular disease (Mellen et al. 2008).

Although health benefits can be expected, the addition of whole-meal flours or fibber cause technological changes. In recent years traditional sourdough bread production has enjoyed renewed success with the ever-increasing demand by the consumer for more natural,

tasty and healthy foods. Sourdough has proven useful in improving the texture and palatability of cereal products (Salovaara et al. 1987, Collar et al. 1994, Meignen et al. 2001, Simonson et al. 2003, Gül et al. 2005, Katina et al. 2006).

Sourdough is an intermediate product for dough and bread preparation and contains metabolically active microorganisms. It comprises a mixture of lactic acid bacteria (LAB) and yeasts (Carnevali 2007, De Vuyst and Vancanneyt 2007), where the dominant are the lactic acid bacteria (the LAB: yeasts ratio in sourdough is generally 100:1) (Corsetti and Settanni 2007, Gobbetti 1998, Ottogalli 1996, Gobbetti et al. 1994). Lactic acid bacteria fermentation creates optimum pH for the activity of endogenous factors (Thiele et al. 2002) which improves texture changes (Clarke et al. 2004), contributes directly to bread flavour, especially, through the synthesis of acetic acid (Ur-Rehman et al. 2006, Gobbetti et al. 2005), increases the loaf volume (Corsetti et al. 1998), delays starch retrogradation and bread firming and inhibits ropiness by spore-forming bacteria (Mentes et al. 2007, Messens and De Vuyst 2002). Rheology, flavor and nutritional properties of sourdough-based baked products greatly rely on their activity.

Material and Methods

Raw material

The flours: wheat (T650 white bread), rye (T930 dark bread), buckwheat (whole grain) were produced by mill house Zrno, Šišov, Slovakia. Wheat dietary fibre was obtained from the Slovak company ADIVIT Ltd., Nitra, Slovakia. Bakers' yeasts and salt were from store. β -glucan was isolated from cereals (Gajdošová et al. 2007) and was prepared as hydrogel, its concentration was 2%. Starter culture containing a mixture of *Lactobacillus paralimentarius* isolate PB3, *Lactobacillus paralimentarius* isolate PB4, *Lactobacillus helveticus* isolate PB7 and *Lactobacillus brevis* isolate PB12, was set up under laboratory conditions. The lactobacilli were isolated from sourdough from Slovak bakeries and they come under collection of Department of Nutrition and Food Assessment, Slovak Technical University. The size of lactobacilli inoculum was 10^7 cfu/g of culture.

Preparation of sourdough

The first stage of sourdough was made by mixing rye flour and tap water at dough yield, DY, 300. The dough yield is defined as $DY = (\text{amount of flour} + \text{amount of water}) \cdot 100 / \text{amount of}$

flour. The addition of starter culture was 5% for dough. Mixture was fermented at 30°C for 22 h. Second stage sourdough was made by mixing rye flour and tap water at DY 170. The first stage sourdough was added by 10% for dough. Fermentation took place at 30°C for 72 h. These ready sourdough was used for baking. Sourdough fermentation was carried out in bucket placed in a thermostat.

Preparation of breads

The bread types were prepared at the company ADIVIT Ltd. Nitra, Slovakia. Basic dough recipe on 2000 g flour basis consisted of wheat flour 60%, rye flour 40%, salt 2%, bakers' yeasts 2,5%, caraway seeds 1% (control). Percentages are based on flour weight. Two diverse groups of bread types was prepared, in which five different samples were made. They differ in substitute of whole grain buckwheat, dietary-fibre instead of wheat flour and addition of β -glucan hydrogel to the water. The individual groups varied on sourdough content. The bread types are shown in Tab. 1. Dough was mixed in Diosna Spiral Mixer 5 min slowly and 7 min quick, divided by hand to 630g pieces, stayed at room temperature for 30 min, proofed in Miwe signo system at 35°C for 45 min and baked in baking oven Miwe signo at 250°C for 30 min.

Tab. 1: Names and composition of bread types

Sample No	Composition of bread samples					
	Wheat flour	Rye flour	Dietary-fibre	Whole grain buckwheat flour	β -glucan hydrogel	Sourdough
1	60%	40%	-	-	-	-
2	45%	40%	-	15%	-	-
3	50%	40%	10%	-	-	-
4	60%	40%	-	-	12,5%	-
5	45%	30%	10%	15%	12,5%	-
6	50%	40%	10%	-	12,5%	-
1SC	60%	40%	-	-	-	+
2SC	45%	40%	-	15%	-	+
3SC	50%	40%	10%	-	-	+
4SC	60%	40%	-	-	12,5%	+
5SC	45%	30%	10%	15%	12,5%	+
6SC	50%	40%	10%	-	12,5%	+

Instrumental analysis

Bread volume was determined by a rapeseed displacement methods according to STN 56 0116 (volume to mass ratio) and the specific volume was calculated. Bread height and diameter were measured by slide rule and the shape (height to diameter ratio) was calculated. Crumb penetration test was carried out by penetrometer AP 4/1 according to STN 56 0116. Crumb firmness was measured at days 1, 2 and 5 to assess the potential shelf-life of the breads.

Sensory analysis

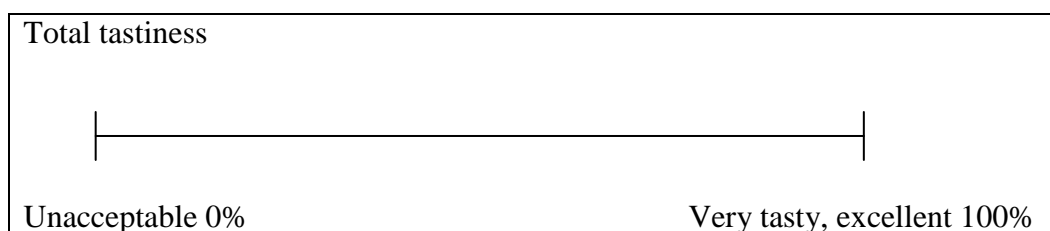
The sensoric evaluation of the final products was done by 10 trained evaluators according to ISO 8586. The whole bread samples were presented to evaluate appearance (form of product, colour of crumb) using five points hedonic scale (Tab. 2). For assessment of porosity and stickiness of crumb small slices (5x5 cm) were used. The determinations were assessed in the way that the highest grade, 4, in the evaluation corresponded with the fulfilment of all demands for organoleptic properties and the lowest grade marked 0 meant major qualitative deficiencies.

Tab. 2: Scale of the sensory scoring evaluation of bread

Form of product	4	Good domed
	3	Moderately domed
	2	Soft domed
	1	Irregular
	0	Spread, cracks
Porosity of crumb	4	Uniform, fine walls, medium pores
	3	Less uniform, soft walls, medium pores
	2	Non-uniform, ruder walls, small void
	1	Crumbly, dense pores
	0	Smear, divided of crumbs
Colour of crumb	4	Typical
	3	Soft tone
	2	Darker tone
	1	Darkness
	0	Dark
Stickiness of crumb (to palate during long mastication)	4	Very few adhesive, easy separate
	3	Few adhesive, separate
	2	Medium adhesive
	1	Adhesive
	0	Unacceptable

The aroma, taste and the total flavour (%) of bread was evaluated graphically by means of the 100 mm unstructured line scale (Tab. 3). Five sensory attributes reviewing the taste (pleasantness typical, grass like, bitter, dummy, and total pleasantness) and aroma (typical, foreign, cinder, mouldy and total) were used to describe the profile of product. Plain water was applied to rinse mouth between several samples.

Table 3: Scale of the sensory scoring evaluation of bread by unstructured line



Results and Discussion

Particular breads were evaluated 24 h after baking. The evaluated physical and sensory parameters by hedonic scale are given the Table 4.

Table 4: Physical and sensory characteristics of prepared bread types

Physical parameter		Sample 1 / 1SC	Sample 2 / 2SC	Sample 3 / 3SC	Sample 4 / 4SC	Sample 5 / 5SC	Sample 6 / 6SC
Specific volume (cm ³ /g)		3,13 / 3,78	2,64 / 2,89	3,09 / 3,31	3,12 / 3,73	2,78 / 2,97	3,10 / 3,70
Shape (height/diameter)		0,57/ 0,65	0,35 / 0,46	0,48 / 0,57	0,58 / 0,66	0,40 / 0,47	0,53 / 0,62
Penetrometer number (PJ = 0,1mm)	1 day	37 / 53	28 / 31	38 / 44	36 / 53	30 / 34	35 / 53
	2 day	25 / 33	19 / 21	29 / 32	24 / 34	20 / 26	29 / 33
	5 day	18 / 25	9 / 15	18 / 22	19 / 25	11 / 16	20 / 25
Senzory parameter		Sample 1 / 1SC	Sample 2 / 2SC	Sample 3 / 3SC	Sample 4 / 4SC	Sample 5 / 5SC	Sample 6 / 6SC
Form of product		3,5 / 4,0	2,5 / 3,2	3,4 / 3,7	3,2 / 3,4	3,6 / 4,0	3,6 / 4,0
Porosity of crumb		3,5 / 3,8	3,1 / 3,6	3,5 / 3,5	3,5 / 3,5	3,2 / 3,4	3,5 / 3,9
Colour of crumb		4,0 / 4,0	3,8 / 3,8	3,4 / 3,7	3,1 / 3,3	3,0 / 3,0	3,6 / 3,8
Tackiness of crumb (to palate during long mastication)		3,6 / 3,9	3,2 / 3,7	3,6 / 3,6	3,5 / 3,8	3,3 / 3,7	3,6 / 4,0

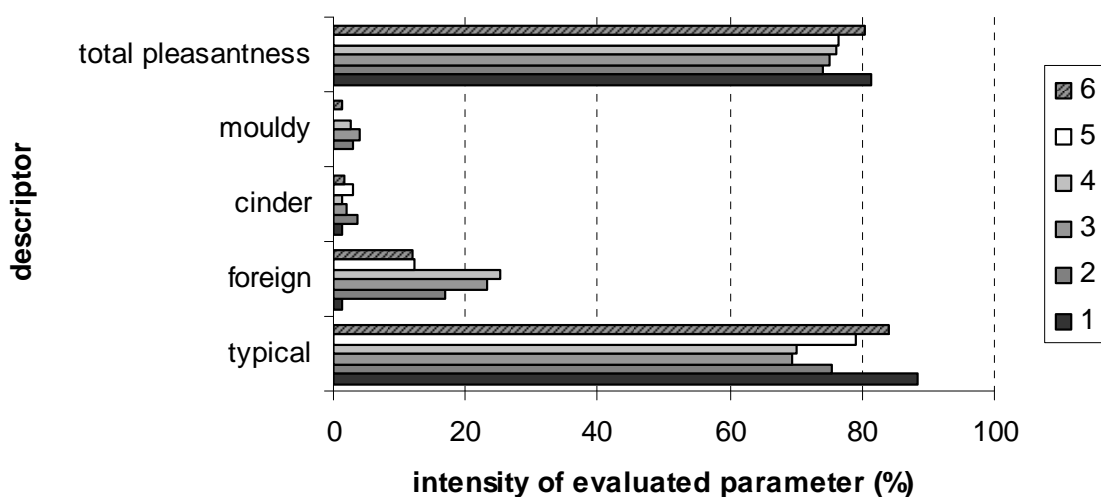
The specific volume of whole grain bread types was lower. With the addition of dietary fibre decreased, but not significantly. β -glucan hydrogel has no influence on this parameter. The

addition whole grain buckwheat and dietary fibre affected the shapes of breads giving flatter products. When compared according to sourdough content, sourdough contributed to improvement of volume and shape of products.

Penetrometer number showed that there were differences in the elasticity between group of bread with used sourdough and the second group without used it. This indicate the better quality of crumb of breads prepared with sourdough.

By means of monitoring listed parameters, there were observed some differences in the form of product, porosity of crumb and tackiness of crumb between samples with and without addition of sourdough. Form of product was improved at 7,5-12,5% against to bread samples without sourdough. The changes in porosity was noticed only in samples 2 against 2SC and 4 against 4SC. Assessors described that also tackiness of crumb was worse in whole grain buckwheat samples (2 and 4), but against them, sourdough types (2SC and 4SC) were better. These sensory parameters were assessed by using five points hedonic scale.

Differences were also recorded in the aroma. Evaluators assessed descriptors such as typical, foreign, cinder, mouldy and total pleasantness graphically by unstructured line (Fig 1). Wholegrain and high-fibre bread types noted considerable foreign character. With application sourdough, these undesirable characteristic were suppressed and the total pleasantness were better.



a)

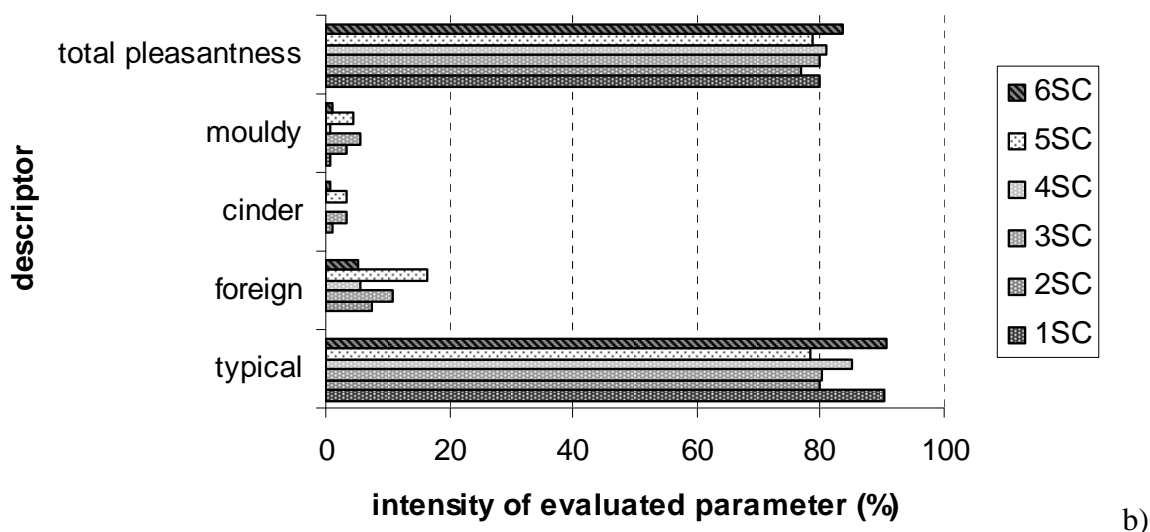
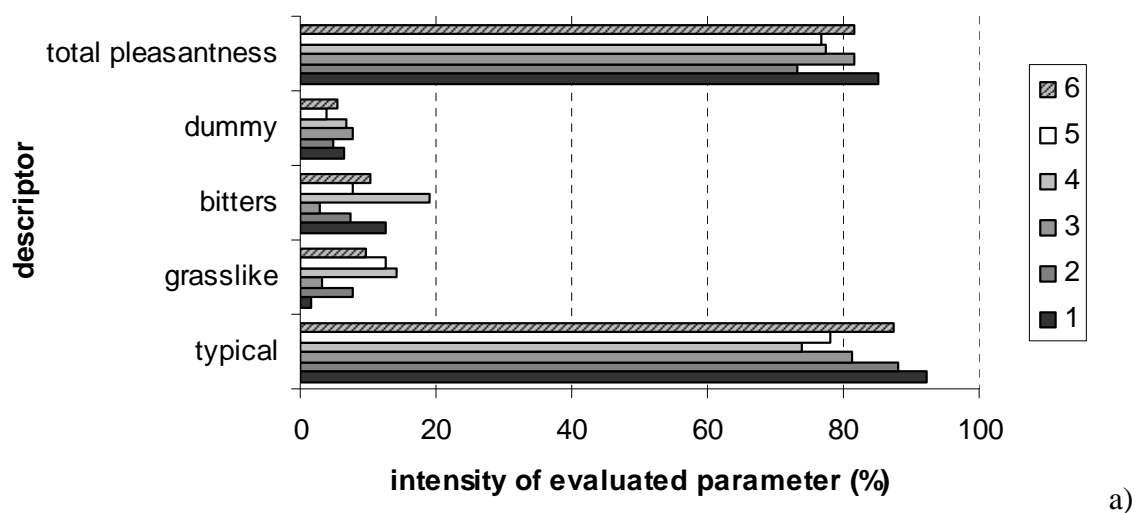
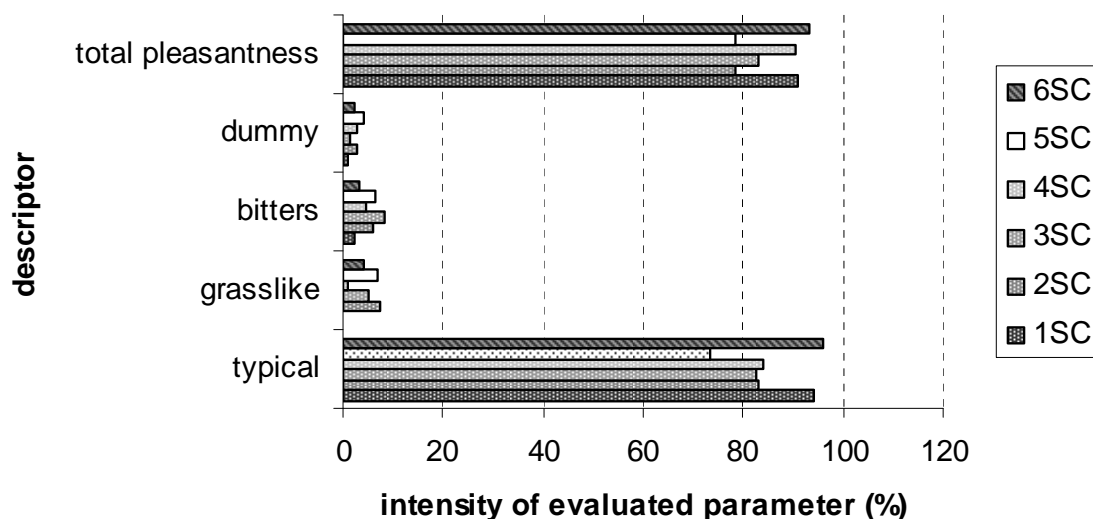


Fig 1: Evaluation of aroma descriptors by unstructured line scale a) without sourdough bread types, b) with sourdough bread types

Substantial differences were recorded by the evaluators in the dummy, bitter and grass-like taste by using sourdough, where these unsuitable parameters were decreased (Fig 2).

Although β -glucan hydrogel did not influence all aroma and form and shape of product, the taste was affected, but in this sample (4SC) the best reduction of bitter taste against sample 4 was achieved. Typical taste and total pleasantness was improved by used sourdough.





b)

Fig 2: Evaluation of taste descriptors by unstructured line scale a) without sourdough bread types, b) with sourdough bread types

The most favoured bread by the evaluators was sample No 6SC, bread with addition of 10% dietary-fibre, 12,5% β -glucan hydrogel and sourdough (Fig 3). Total flavour score was 96,3%. Based on experimental results it can be concluded that the addition of sourdough has proven useful in improving the texture and palatability of whole grain and fiber-rich products. All the samples with sourdough scored higher sensory characteristics when compared to samples without sourdough. It was also noted positive effects on prolonged shelf-life.

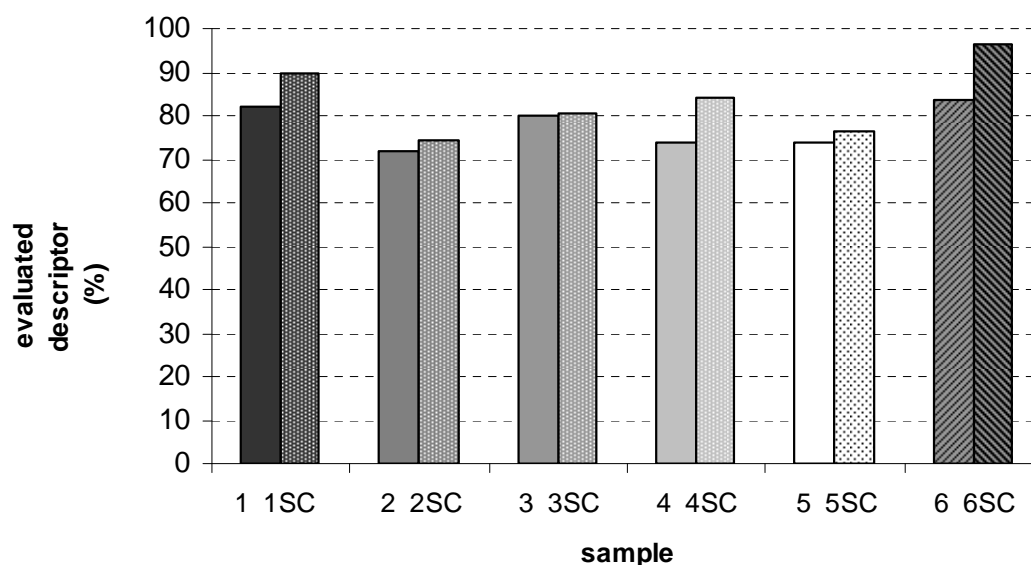


Fig. 3: Evaluation of total flavour of bread types by unstructured line scale

Acknowledgements

The authors would like to thank the company ADIVIT Ltd., Nitra (Slovakia) for expert assistance and providing the baking bread types. Also the authors acknowledge the financial support by projects APVV-0310-06, AV 4/0013/07 and Vega 1/0845/08.

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